IX. *On the means by which the Honey Bee finds its way back to the Hive.* *By* George Newport, F.R.C.S. &c. President of the Entomological Society.

[Read 6 February, 1843.]

Great difference of opinion has existed amongst naturalists as to the means by which the honey bee finds its way back to the hive it has left, and distinguishes its own residence from that of others. Some, most naturally, have believed that it is simply by the sense of vision; others, that it is by means of that of hearing, or of smell. Those who contend for the latter opinion have fancied that the bee is conducted by the odour of the flowers she has visited in her outward course:

"*The varied scents that charmed her as she flew.*"

But this opinion is at once invalidated by the circumstance, remarked by Dr. Bevan, that when a bee is returning to its hive, its flight is usually in a direct line. Indeed every observer must have remarked that the bee, like the carrier pigeon, after it has taken its first circuitous flight of recognition, is led by an almost unerring instinct directly to its home. Yet it is much to be questioned, whether it is simply by what we term instinct,—a term which we cannot sufficiently explain or fully comprehend,—that these animals are directed in their course; or whether it does not chiefly depend on the perfection of one or more of their senses? One variety of the common dog will discover his master or his home by the sense of smell, but another, as the greyhound, simply by that of sight. All naturalists are aware that the sense of vision exists in the greatest perfection in vertebrated animals, in birds of flight, and such is the case in volant insects amongst the invertebrated. It is by means of this sense, the most perfectly developed of all the senses of insects, that the honey bee, as I am disposed to think, finds its way back to the hive, notwithstanding that some observations of naturalists seem to lead to a different conclusion. In order to put this opinion to the test of experiment, on the 11th of March, 1836, I removed one of my straw hives from the closed bee-house in which it had stood through the winter, to a stool in the open air, within sight of, but at a distance of about ten or fifteen yards from the bee-house. On the following day, the 12th, scarcely a bee went abroad, either from the bee-house or the removed hive; or from another straw hive which stood very near to it; the weather being exceedingly wet and boisterous. The 13th was a remarkably fine day, and

many bees went abroad, both from the bee-house and from one of the straw hives, and returned loaded with pollen; but I did not observe even a single bee return to the straw hive that had been removed, and very rarely any depart from it. But although not a single bee returned to that hive, I frequently observed a few bees descending towards and alighting at the entrance hole in the bee-house from whence that hive had been removed. This entrance hole had been closed since the removal of the hive, and the bees collected around it made many attempts to enter, and were quickly in a state of great excitement. On opening the hole and allowing them to enter, they ran around the place on which the hive had stood in great agitation, vibrating their half-closed wings most rapidly, and touching each other repeatedly with their antennæ, as if in a state of frenzy. Two or three bees then issued from the entrance hole, and after taking a circling flight twice or thrice in the air, at some distance from the bee-house, as if to reconnoitre the spot, alighted again at the hole, and ran about within in the same state of consternation as before. After continuing in this state for some time they flew to the entrance hole of the hive which remained in the bee-house, but were very badly received. The bees of that hive resisted and maltreated them, and several fights ensued, in which the intruders were killed. It was thus evident that these bees belonged to the hive that had been removed, which, perhaps, they had left but a short time before, without reconnoitring the new locality of their residence,—which a bee seldom or ever appears to do when its hive has remained undisturbed on the same spot for any great length of time,—and, consequently, having never distinguished their home but by the exterior of the bee-house, they now returned directly to the spot where they had been accustomed to enter. This experiment seems to show that the bee is not conducted by the sense of smell, either of the honey or of the inhabitants of the hive, or it could hardly have been attracted to a spot from whence these were removed. Neither can we suppose that it was directed by the sense of hearing, or it could hardly have failed to recognize the sounds in its own hive, which stood at so short a distance; while the circumstance of its flying directly to the spot where it had formerly entered, and that of its leaving the entrance hole on finding the hive removed, and then flying around in the air as if to reconnoitre the bee-house, and alighting a second time at the same hole, seem to prove that the great faculty exercised by it in discovering its home is that of sight. This experiment seems also to explain why so few bees left the removed hive, those

which had gone out not having returned, as Huber believes, to apprise the population that remained of the quantity of honey abroad, or of the favourableness of the atmosphere for collecting it.

One great anatomical fact which tends to support the opinion I am now advocating, that the bee usually finds its way back to the hive chiefly by the sense of sight, is the great extent to which the organ of vision is developed, and the peculiar fitness which the telescopic structure of the multitude of eyes of which the organ is composed possesses for viewing distant objects. Every one of the many thousands of lenses on the surface of the organ has been proved, by the researches of Müller, Straus-Durckheim, and others, to be the inlet to a distinct eye lined with its proper choroid and retina, or nervous expansion, to which the impression of the images of distant objects received by the lenslike cornea are conveyed. The distance at which objects are clearly distinguished by the insect is dependant chiefly on two circumstances:—the relative diameter and convexity of the cornea to that of the whole eye; and the length of the chamber from the cornea to the retina, or expansion of the nerve. Now these conditions vary in different insects, and seem to have much reference to their habits. In those species in which the cornea is of great breadth, and the length of the chamber, or distance from the cornea to the retina, is very short, as in some of the *Diptera*, the distance at which objects are distinctly observed is necessarily restricted; but in those in which the corneæ are numerous and small, and each forms on the surface a large segment of a circle, and the length of the chamber several times exceeds that of the breadth of the cornea, as in the bee, the distance of vision is greater in proportion to the length of the chamber, and the acuteness of the angle at which the rays of light impinge on the retina at its base. This, perhaps, may explain the reason why some of the corneæ on the inferior portion of the mass of eyes are of greater diameter, and have the chambers shorter than those of the upper and exterior surface; so that some of these corneæ have a greater sphere of vision, but a shorter focal distance; and thus are adapted for viewing near, as the others are more distant objects.

This structure of the organ of vision in the bee is entirely in accordance with the usual mode of proceeding of this insect, and illustrates the fact of the bees leaving the bee-house and flying around in the air as if to reconnoitre the spot; and also another fact, which has in part been observed by others, and which I have frequently witnessed, namely, that for the first few days after a swarm has been hived the bees seldom fly far, and each bee, on

first leaving the new hive, usually makes several circuits around it in the air, at greater and greater distances, with its head constantly directed towards the hive, as if to reconnoitre the spot prior to its taking a distant flight.

These considerations lead me to the conclusion that it is chiefly by means of vision that bees and other insects find their way back to their homes.

P. S.—Since this paper was read to the Society it has been referred to the judgment of Dr. Bevan, the most accurate and philosophic of our practical English apiarians; and it gives me great pleasure to learn that the views which it contains are in entire accordance with those entertained by that distinguished naturalist. Dr. Bevan states, that most of the facts now adduced in support of the opinion, that the bee depends upon its visual organs to guide its unerring flight, he can confirm by repeated observations of his own; and he adds that, in conformity with this opinion, "it is my practice, if any occasion occur to induce me, to change the site of a family of bees in my garden, or to any other place within the usual range of their flight, to prevent their egress for a time, longer or shorter, according to the season. This has the effect of rendering them circumspect, and makes them look about them prior to their taking flight from their new locality. Acting also on the same opinion, I am in the habit of marking all the entrances to my bee-boxes with different colours, to secure their occupants against committing mistakes, though I have some doubt as to the necessity of this measure."—(Dr. Bevan in lit.)

To these observations I may add some further remarks. It is by the sense of vision that the drone of the hive discovers his royal partner in the air, during his short excursive flights; and celebrates there his connubial duties, as believed by Huber;*

* I have no doubt that this opinion of Huber's is correct. I once found, about noon, on a very fine calm day, in the beginning of May, a drone hive bee, which I saw fall to the ground enfeebled and mutilated in the particular way described by Huber. This happened at a distance of from two to three hundred yards from some cottages where bees were kept. Every one also must have noticed the pairing of butterflies in the air. This is the constant habit of the diurnal *Lepidoptera*, and I have reason to believe that these species will not pair in confinement. During the past summer I have reared more than one hundred specimens of *Vanessa urticæ*, and also nearly as many of *Vanessa Io;* and although the sexes of each were confined together in the same breeding cage, and the bodies of the females became fully distended by the development of the ova, *not a single act of connubial intercourse took place*, but the whole died, both males and females, at the end of a few weeks, the females without depositing even a single egg.

and, as if watching for her departure, I have repeatedly seen him, at midday, wheeling his heavy oscillatory flight in front of the bee-house, with his head constantly directed towards the entrance of the hive. Every one must have remarked the acuteness of sight in the dragon-fly, and with what instantaneousness it avoids the approach of danger, even at a considerable distance,—darting upwards, sideways, and in every direction, when chased by the swallow on the stream,—and when danger is passed that it constantly returns to the same spot. It captures its prey by sight, with the rapidity of thought, while hovering continually over the same water-plant; and, after an extensive flight around the pool, by the hedge-row, or in the air, hawking in quest of food, it returns again and again with its captures, and alights to devour them on the selfsame leaf.

The whole family of butterflies also are in the habit of returning to the same spot within a very short period. The cabbage butterflies repeatedly visit the same plants. The nettle butterfly usually revisits the same group of nettles after less than an hour's absence; and I have often observed the gay autumnal species, *Vanessa Atalanta*, at the end of September, when but few flowers are in bloom, return frequently to the selfsame group of blossoms of an *Arbutus*, although the shrub was secluded and almost hidden by larger plants. This occurred not merely on the same day, but on the fine mornings of succeeding days.

Who can doubt that these, the gayest of nature's children, are directed in their movements by that sense with which nature has provided them to a greater extent than any other of her magnificent productions? or that to this endowment she has added a recollection of locality and of objects once recognized, observed by means of that perfected sense? This is proved to be the fact by the proceedings of the little solitary bee *Megachile centuncularis*, which I have detailed on a former page of this volume. By the sense of vision this insect was led to select that material, the *carded cotton cloth*, which it was impossible for her to have found in a state of nature in this country, and yet which was the best adapted for her object in departing from her usual habit; while on two succeeding days she remembered the locality in which it was to be obtained, and returned again and again to the same spot to procure that which she regarded as best fitted for her purpose.